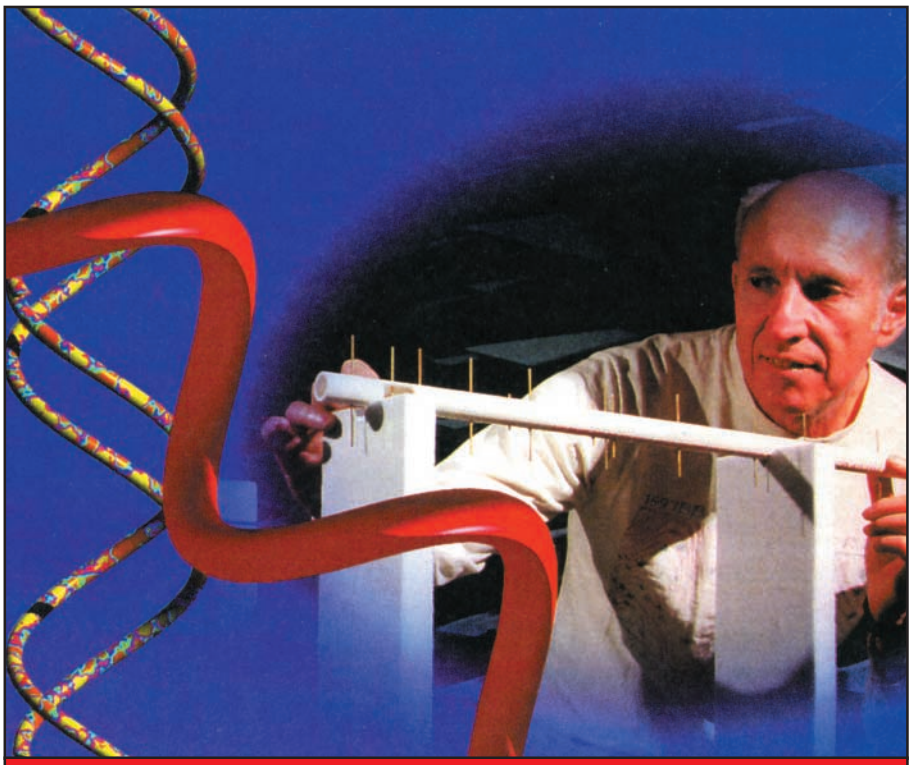
Air Force Research Laboratory | AFRL

Science and Technology for Tomorrow's Aerospace Forces

Success Story

GENETIC ALGORITHMS IMPROVE ANTENNA PERFORMANCE



Courtesy of Communications Quarterly

As the Air Force migrates to space, Sensors Directorate researchers recognize an emphasis on increased antenna performance. Using genetic algorithms for antenna design generates antenna configurations never before seen. Genetic algorithm technology provides a deeper breadth of antenna design, saving time and, consequently, money in the development of new antenna technology.

Air Force Research Laboratory
Wright-Patterson AFB OH

Accomplishment

Directorate researchers refined a well-known optimization technique for antenna design through an in-house research and development effort. Genetic algorithms allow researchers to develop antennas that outperform those previously available. The success of this research resulted in the award of US Patent No. 5,719,794, entitled "Process for the Design of Antennas Using Genetic Algorithms."

Background

A variety of wire antennas exist including dipole, monopole, rhombic, the beverage, the yagi, the log-periodic, the loop, the helix, and the spiral antenna. The design of these antennas relied mainly on the use of trial and error techniques. Researchers, using ingenuity and intuition, created a better antenna, or used existing antenna configurations, to apply changes until they obtained an acceptable design.

The increased need for improved performance led to the innovative use of genetic algorithms. This mathematical phenomenon, first investigated in the 1970s, had limited application because it needed greater computational capabilities. The availability of high-speed computers permits researchers to use the genetic algorithm for many new applications, including antenna design.

In this process, the engineer specifies the desired antenna parameters using a synthesis approach, then the genetic algorithm attempts to find the best antenna configuration for the intended application. A genetic algorithm randomly selects several hundred possible configurations from a very large population and identifies each configuration by a chromosome (a string of zeros and ones).

The algorithm uses a computer numerical electromagnetic code to compute the performance of each configuration. The algorithm then ranks the configurations from best to poorest performance and mates the best performers. The mating process continues until an optimal solution is reached.

This process produces some unique and efficient antennas while saving significant research time. Antennas that may have taken months or even years to develop, now take days or even hours. Smaller antennas are necessary to make Air Force technologies space ready. A conventional antenna becomes inefficient once it reaches approximately a tenth of a wavelength in size. Researchers use the genetic algorithm for antenna design to develop very small resonant antennas that are as small as a thirtieth of a wavelength in height.

Sensors
Emerging Technologies

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTT, (800) 203-6451 and you will be directed to the appropriate Laboratory expert. (01-SN-06)